

# **Sterling & Associates' White Paper on the Year 2000**

***“The year 2000 will be the first century change ever endured by an automated society, and if your organization uses computers, that means you are sitting on a time bomb.”– Computerworld***

This may sound like a quote from a science fiction story, but it is actually an example of the alarm being sounded in computer journals these days about the approaching millennium. So what is so important about the year 2000 and why is it expected to affect computer systems? And what is this time bomb they are talking about? Can anything be done to diffuse it?

We believe, that through timely education, planning and action, organizations using computers can celebrate the millennium along with everyone else.

This white paper has three purposes. First, it will describe what we know about the century change problem that has so many IS managers concerned. The paper then lists what we do not know—specifically what we don't yet know about how this problem may affect the state of Washington. Finally, we propose a phased plan for addressing this important issue.

## ***Most systems make extensive use of dates for computations***

It's difficult to think of a business transaction that doesn't use dates in some way. For example, consider this short list of activities commonly performed by government:

- Eligibility determination
- Interest calculation
- Issuing licenses and permits
- Processing payments
- Registration and enrollments
- Long-term debt management
- Court docket scheduling
- Inventory management
- Forecasting and budget preparation
- Project planning and management

In these and other activities, correct date information is essential for the proper action, calculation or information to be produced. Because computer systems support business activities, they make extensive use of dates in calculations or comparisons in order to carry out their functions.

# **Sterling & Associates' White Paper on the Year 2000**

## ***System programming standards have used six digits for dates***

System programmers in the past adopted a six digit standard format for coding dates in their programs. The month, day and year are each indicated using two digits—MM/DD/YY.

Thus *November 30, 1994* is stored as **11 / 30 / 94**

The standard reserved no spaces to indicate the century in order to minimize expensive data storage space and data entry requirements.

This standard was commonly used in software written in the 1970s through the mid-1980s. Some newer applications may also use this standard. Although new eight-digit date standards—MM/DD/CCYY—are becoming more common, most in-house applications, vendor software, and outside data sources used today employ the six-digit date in some manner.

The six-digit format has served us well for the most part. But as we begin to need to use the year 2000 in our systems for projections, expirations, comparisons and calculations, the standard format will not provide adequate space to determine the correct year. How will the computer know whether year 00 refers to the year 1900 or the year 2000?

Data sort routines will produce confusing results if only the last two digits of the year are used. In comparing an event in 1998 with an event in 2005, the computer will actually be comparing 98 with 05. Without a century indicator, the computer will logically, though incorrectly, determine that 2005 is an earlier event than 1998. Computers must have more information than is contained in the six-digit standard in order to tell the difference between events in the early 20th and 21st centuries.<sup>1</sup>

## ***Computations using only six digits will produce wrong answers***

The standard format does not provide enough information to ensure accurate calculations that so many processes depend on—particularly subtractions and comparisons. For example, a date subtraction is often used to determine length of time or age. To calculate the age of someone born in 1940 the computer subtracts the birth year from the current year.

$$\begin{array}{r} 94 \\ -40 \\ \hline 54 \end{array}$$

*54 years old*

---

<sup>1</sup> Peter De Janger, "Doomsday," Computerworld. September 6, 1993, pp. 105, 108.

# **Sterling & Associates' White Paper on the Year 2000**

In the year 2000, however the calculation will produce:

$$\begin{array}{r} 00 \\ -40 \\ \hline -40 \end{array}$$

*Negative 40 years old!*

This is just one example of how a calculation may be corrupted by the century change. Unless applications are reprogrammed to expand the date fields to eight digits or to change the calculation routines, the functions relying on such calculations will fail.

## ***Dates are used in programs for a variety of purposes***

Computers use dates in other ways. Dates are often used as embedded information fields—part of the transaction or item identification number—in functions such as inventory, transaction history, or process control. Operating system software dates are often referenced and used by applications software for various functions.<sup>2</sup>

Computer programs also employ date calculations in error checking routines. Some applications are programmed to return error messages if the year entered is equal to 99 or 00, or if a date calculation produces a negative number. Unisys is working to correct potential problems in some of its systems caused by the binary representation of dates in these systems. The problem would begin to affect these systems in 1996.

Systems operating at the end of this millennium with the six-digit date field may fail in more ways than one.

## ***Changing the dates in the programs will not be enough***

Because dates are used in computers for different purposes, different kinds of changes will be needed to ensure that existing programs produce the same results in the next century. In some cases, expanding the date field will eliminate the problem. In other cases, computer algorithms must be rewritten to maintain the proper logic. A line-by-line code review will be required to locate, analyze, and correct potential date-related problems in many systems.

In addition to changing the program code, front and back-end systems may need to be revised. For example, data entry screens and forms will need to be able to accommodate the eight-digit date. Data storage will need to be

---

<sup>2</sup> Larry W. Martin, "Millennium Preparation," Software Magazine, Vol. 13 no. 10 (July 1993), p.6.

# **Sterling & Associates' White Paper on the Year 2000**

expanded and history files may need to be modified in order to be usable after programs have been changed. Report formats may also need to be redesigned.

## ***No one expected legacy systems to last to the year 2000***

About now, you may be wondering how the world ended up in this situation. The answer contains some good news and some bad news. Few programmers or organizations expected that systems they built 10 - 20 years ago (systems we now call legacy systems) would still be in use on the eve of the millennium. The good news is that these systems continue to provide value beyond their expected useful life.

The bad news is that government and business are depending on thousands of mission-critical legacy systems with date formats unable to support the century change.

## ***Significant costs are expected to solve the problem***

Published reports estimate that Fortune 50 companies will each spend \$50 to \$100 million to solve the problem.<sup>3</sup> Viasoft identifies three factors which contribute to the potentially significant cost:

- The large number of applications, programs, and data files affected;
- The use of dates by vendor and PC software; and
- Time-consuming planning and analysis tasks.<sup>4</sup>

## ***Many systems are poorly documented and understood***

One contributing factor to the estimated cost is that systems, particularly old legacy systems, are often poorly documented. The original programmers have often long since left the organization. It is no simple task to comb through thousands of lines of code 1) to find instances where the standard date format is used, and 2) to then verify the desired result of the calculation or comparison to ensure that any reprogramming will produce that desired result.

## ***A wide-spread view that January 1, 2000 is far in the future***

The year 2000 captures our imagination—a numeric symbol of a new frontier. Yet we are almost there, especially when you break down the years into the number of work days available. There are 1,272 state work days between December 1, 1994 and the new millennium. If the century change issue is not

---

<sup>3</sup> Peter De Janger, "Ibid.

<sup>4</sup> Viasoft, Inc., "Changing Computer Systems to Process in the Year 2000", August 1994.

# **Sterling & Associates' White Paper on the Year 2000**

addressed at all during the 95-97 biennium, there will be less than 625 work days to correct the problem.

Right Source, Inc. prepared a study of the estimated resources needed to address the problem based on the lead time allotted. They assumed that each program will require 11 days to analyze, design and make changes, test and place into production.<sup>5</sup> An organization with 2500 programs will need more than 23 full-time programmers to accomplish the task by the end of 1999—38 if it waits until 1997 to begin.

## ***Systems may experience date problems before the Year 2000***

Systems may begin to falter or fail before the year 2000 depending on their event horizon. By event horizon we mean the latest future date that an application processes. For example, budget systems often have a four or five year event horizon. The Department of Information Services recently conducted a brief survey of how the century change problem is viewed in state agencies. Several reported they are already experiencing some date-related system problems:

- OFM reports that customers already need to enter project dates beyond 1999.
- Administrator for the Courts notes that court calendar dates are now being set into the next decade.
- Department of Licensing will be affected as early as 1995.
- DSHS Social Service Payment System (SSPS) will begin to fail on July 1, 1998 due to 18 month program authorizations. DSHS estimates that it would require in excess of \$650,000 to fix the SSPS date problem, without adding any new system functionality.

Companies already in the process of correcting their date problems recommend that others test their current and corrected systems for transactions in years on either side of the year 2000, in addition to the year 2000 itself. Many system calculations have failed on dates near the year 2000.

## ***Systems maintenance and enhancement requests take precedence over future problems***

In many organizations, significant IS staff resources are committed to maintaining and enhancing legacy systems. Many of these systems require significant daily intervention and care to keep them functioning properly. Few

---

<sup>5</sup> Ibid.

# **Sterling & Associates' White Paper on the Year 2000**

staff resources are available to be devoted to the investigation and correction of century date problems. Other IS organizations have found it difficult to persuade their customers that currently desired enhancements should be reprioritized in favor of correcting a seemingly distant problem.

Availability of legacy system programmers will become increasingly scarce. Time is not the only increasingly scarce resource needed to address this problem. The number of programmers with legacy system expertise dwindles every day. The new generation of application programmers are being trained in advanced object-oriented programming languages and express no interest in learning COBOL which is the language used by most legacy systems. Seasoned COBOL programmers are "graying" and may be retiring by the end of this millennium.

The pool of appropriately experienced programmers is shrinking, but the millennium date problem will potentially affect every mainframe system owner in the world. Large companies are already starting to lock-in the resources they will need to take care of their needs through the end of the millennium. The longer system owners wait to fix the problem, the fewer programmers they will find available to help them. One may expect that the price for those resources may skyrocket as the demand for their talents escalates.

## ***Many state agencies have not yet addressed the problem***

DIS conducted a survey of state agencies regarding their awareness of the century date problem and the efforts they've made to-date to address the problem. Of the 32 agencies responding to date, more than half indicated that they have done at least some research or planning. Nearly half of the agencies reported they have not raised this as a critical issue to the organization outside of the IS division.

## ***Agencies which have investigated the problem have been sobered by their analyses***

Several agencies reported that they have already performed a thorough review of their systems, identifying the estimated size of the problem and developing budgets and workplans. Some of these agencies have identified a potentially large system impact and significant resources needed to address the problem fully. Several agencies that estimate the problem to be a small one reported they have conducted no research to-date. In the last section we described the types of problems that may be caused by the century change. The biggest problem for the state of Washington today is that we don't know the extent to which these potential problems are real problems for state government. In this section we list the types of information that the state of Washington needs in

# **Sterling & Associates' White Paper on the Year 2000**

order to plan and to carry out the corrections necessary to ensure a graceful system transition to the new century.

## ***State government does not have a comprehensive assessment of this issue and its implications***

The brief survey by DIS hints at the spectrum of understanding and responsiveness to this issue among state agencies. Some agencies have not begun to address the problem, others may not even be aware of the problem. Some agencies aware of the problem have not yet brought this to the attention of agency management.

We do not know if the century date issue is one that can be easily handled at the agency level with little or no extra funding, or if this is a wide-spread interagency problem which will benefit from significant resources and oversight.

The impacts of these changes on the stability of systems is not known. Because we do not yet know the magnitude of the problem or the types of problems caused by standard dates in the state's systems, we cannot assess the risks related to reprogramming systems to correct these errors. We have seen mission-critical systems in other jurisdictions become corrupted when they were modified for similar problems—this in part because these systems were old, patched and ill-documented.

Indeed some of the state's systems may also be so poorly documented or fragile that system stability cannot be assured if major corrections are made. In some cases it may be preferable to replace systems than to repair them. At this time, the state lacks information to make this assessment.

## ***The time frame and cost to correct this problem is unknown***

Because we do not know the nature and extent of the date problems in state systems, or the risks to correcting these problems, we cannot yet estimate the time or cost required to correct the problem. Because the nature of the problem and the preferred remedy can vary from application to application, it would be dangerous to extrapolate from the research conducted by one or two agencies.

## ***Tools are being developed by vendors, but they have not been thoroughly evaluated***

Vendors, including Viasoft, Data Dimensions, Unisys, and others, are developing and marketing tools to help programmers locate the use of six-digit dates in programming code. These tools have not yet been internally evaluated and to our knowledge, are not currently in use in the state of Washington.

# **Sterling & Associates' White Paper on the Year 2000**

These tools primarily assist programmers in locating sections of code that contains date-related information or algorithms. They do not take away the need for programmers to analyze the purpose of and needed correction for the date-related information in the code.

## ***The capacity and ability of the state work force to confront this problem has not been assessed***

As mentioned in the first section, the world's pool of talent to address this issue is limited. The state has not yet assessed its current capacity and ability to tackle the century date problem. Once the size of the problem has been identified, the state will need to determine the necessary capacity to research the problem and make needed corrections. The state will then need to determine if it currently possesses that capacity, and if not, then how to acquire it.

We are recommending a phased approach to the century change effort for the state of Washington . This phased approach will ensure:

- That what is known about the century date problem will be widely communicated and shared,
- That the gaps in what is known today are filled, and
- That plans for assessing and correcting the problems discovered are developed and implemented.

## **PHASE I: Raise Awareness(*Fiscal Year 1995*)**

### ***Inform state policy makers and executives***

Because the century change issue has the potential to be a large and pervasive problem throughout the state's systems, we believe that state policy makers and executives need to be informed about the nature of the problem and the current lack of information about the state's condition. In addition to the Information Services Board, the Cabinet, other agencies, and key legislators should be educated on the issue.



# **Sterling & Associates' White Paper on the Year 2000**

## ***Notify state agencies of plans for the next phase***

State agencies should be made aware of ISB and DIS interest and commitment to this issue. Agencies should be promptly notified of any state plans developed for the next phases.

## ***Adopt and enforce date field standards***

DIS does not formally have a date-field standard. DIS should either adopt an eight-digit standard or provide agencies with information that will enable them to make wise date-standard decisions.

## **PHASE II: Assessment and Planning (Fiscal Year 1996)**

### ***Evaluate tools to assist with system date changes***

DIS should continue its research and evaluation into the tools now available for assisting programmers in locating needed date changes in application code. DIS should provide agencies with the results of its research and recommend the tool for use by other agencies.

### ***Train agency staff in the use of the selected tool(s)***

Agency staff will need to be trained in any tools or methods used to identify and correct needed date changes. DIS or vendor resources could be used for training.

### ***Perform a comprehensive analysis of agency applications***

All agency applications need to be analyzed to assess their need for date related modifications. A comprehensive analysis is needed to determine the magnitude of the century date problem for the state of Washington and to identify its implications for service delivery, legal compliance and achievement of state goals.

### ***Determine feasibility, costs, benefits and risks***

After the problem has been defined, the state will need to evaluate the options for addressing the problem. Should systems be repaired or replaced? Should bridge options (interim solutions) be considered? Agencies should identify and evaluate the feasibility, costs, benefits and risks of these options.

# **Sterling & Associates' White Paper on the Year 2000**

## ***Develop a comprehensive plan and budget***

After solution options have been selected, agencies should then develop comprehensive and detailed implementation plans. The plans should include schedules, responsibility assignments, task descriptions and timelines, resource requirements and budget estimates. These plans could be submitted to DIS for review and oversight similar to the manner other plans are handled.

## ***Prepare contingency plans***

Because the risk to the state of having mission-critical applications fail could be significant, agencies should prepare contingency plans for operation in the event that systems cannot be replaced or repaired before they begin to be effected by the date change.

# **Sterling & Associates' White Paper on the Year 2000**

## **PHASE III: Implementation (Fiscal Years 1997 - 2000)**

### ***Implement agency plans with DIS and ISB oversight***

When the assessment and planning phase is completed, agencies should begin to implement their plans. Because this issue is of key importance to the success of state government, we believe the century change effort should receive DIS and ISB oversight to ensure plans are progressing on schedule.

DIS can also provide an important role of information clearinghouse to agencies that will be working independently on the same challenges.